CONNECTICUT RIVER FLOOD CONTROL PROJECT

CHICOPEE, MASS.

CONNECTICUT RIVER MASSACHUSETTS

ANALYSIS OF DESIGN FOR BERTHA AVENUE PUMPING STATION

ITEM C.5a-CONTRACT

APRIL 1940

CORPS OF ENGINEERS, U. S. ARMY

U. S. ENGINEER OFFICE, PROVIDENCE, R. I.

CONNECTICUT RIVER FLOOD CONTROL

ANALYSIS OF DESIGN

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CHICOPEE, MASS.

ITEM C.5a.

CORPS OF ENGINEERS, UNITED STATES ARMY

UNITED STATES ENGINEER OFFICE PROVIDENCE, RHODE ISLAND

Page

I. INTRODUCTION

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A. AUTHORIZATION AND PAST REPORTS. - The Bertha Avenue Pumping Station is a part of the local protection works for the City of Chicopee. The Chicopee Dike project is a part of the Connecticut River flood control plan included in the Comprehensive Plan of Flood Control for the Connecticut River as described in House Document No. 455, 75th Congress, 2nd Session, and authorized under the Flood Control Act approved June 28, 1938.

B. NECESSITY FOR THE STATION. - As a part of the flood protection works for that section of Chicopee between the Willimansett Section and the Chicopee River, a pumping station adjacent to the dike near Bertha Avenue is necessary to discharge the sewage and storm run-off into the river and thus prevent the accumulation of water behind the dike above Elevation 55.0 during periods of high water. The drainage area tributary to the Bertha Avenue Pumping Station is 335 acres. This area is drained by a small brook and is served by a 10-inch sanitary sewer. During periods of high water a natural basin adjoining the pumping station will serve as a storage pond for peak discharges of the brook in excess of the pumping capacity. The available capacity of the storage pond is 16.4 acre-feet which can be obtained by allowing the water surface of the pond to rise from Elevation 47.0 to Elevation 55.0 mean sea level datum. Pumping will be necessary when the river stage exceeds Elevation 47.0. During periods of normal river stage the discharge from the brook and the 10-inch sanitary sewer will flow through a gravity conduit to be constructed adjacent to the pumping station into an existing twin pipe conduit under the dike to the river.

bottom page 1.

C. CONSULTATION WITH THE CITY OF CHICOPEE. - Preliminary to and during the actual design of the station, consultations were held with of-

IV. HYDROLOGY.

IV. HYDROLOGY.

A. DRAINAGE AREA CHARACTERISTICS. - The drainage area of 335 acres, tributary to the Bertha Avenue Pumping Station as shown on Plate 1, consists, at the present time, entirely of partially developed and undeveloped land. In estimating the amount of protection to be provided for storm run-off, the entire drainage area is considered as partially developed residential area. The drainage area is divided topographically into three parts of different characteristics. Part C_1 consists of 160 acres of flat undeveloped land having considerable vegetation. Part C_2 consists of 90 acres of wooded bluffs and part C_3 consists of 85 acres of flat farm land containing a large percentage of swampy ground which provides appreciable natural storage. The letter symbol "C" designates partially developed residential areas. With the exception of one 20-inch sewer about 600 feet long, having a capacity of approximately 5 c.f.s., and its 12- inch lateral, the run-off from the entire drainage area is collected in natural channels.

B. RAINFALL RECORDS. - The following table derived from data presented in Miscl. Pub. #204 U.S.D.A., "Rainfall Intensity-Frequency Data" by D. L. Yarnell, presents the best available analysis of rainfall rates for different frequencies and durations to be expected at Chicopee, Massachusetts.

MAXIMUM AVERAGE HOURLY RAINFALL RATES AT CHICOPEE, MASSACHUSETTS.

Frequency years	Duration of storm in minutes			
	30	60	120	240
2	1.96	1.16	0.65	0.50
5	2.50	1.60	0.92	0.62
10	3.00	1.85	1.12	0.75
25	3.90	2.42	1.46	0.94
50	4.10	2.70	1.70	1.06

a composite area it is not necessary to furnish the same degree of protection for a partially developed residential area as a fully developed industrial area. Allowance for this fact is made by introducing the relative-protection-factor (R.P.F.) which is the index of the amount of protection from run-off which one area warrants relative to another. The relative-protection-factor is defined as the ratio of the intensity of precipitation used in computing the run-off from a given area to the intensity of precipitation of the basic design storm. In other words, the adopted basic rainfall intensity multiplied by the R.P.F. gives the rainfall intensity for which protection from run-off is provided. The R.P.F. is a function of the amount of local flooding of short duration, which can be tolerated on the different types of drainage area, and of the relative topographic positions, in the drainage area, of the divisions having different types and states of development. An R.P.F. of 1.0 is used for fully developed industrial and commercial areas, 0.8 for fully developed residential areas, and 0.6 for partially developed areas. A relative-protection-factor of 0.8 corresponds approximately to a 5-year storm as compared to 1.0 for a 10-year storm and 0.6 corresponds approximately to a 2-year storm.

It may occur that a partially developed portion of the drainage area, or one fully developed that is not provided with a complete system of storm drains, is so topographically situated that lines of natural drainage will prevent local ponding, and will concentrate excess run-off in other areas where additional ponding cannot be tolerated. In such cases the relative-protection-factor cannot be considered as a function of type of development only, and it may be desirable in exceptional cases to increase the factor to more than 1.0.

The following divisions of the drainage area, as described in "A", together with appropriate rainfall rates and run-off coefficients were used. Owing to the location and nature of the drainage area it was deemed unnecessary to consider other than the present state of development of the drainage area.

Type	Area Acres	Rainfall in/hr.	Run-off Coefficient	R.P.F.	Q c.f.s.
C_1	160	1.12	0.30	0.60	32.3
C_2	90	1.12	0.80	0.70	56.4
C_3	85	1.12	0.10	0.60	5.2
				Total	93.9

F. STORAGE POND. - It is feasible to use as a storage pond a natural basin in a brook valley that lies adjacent to the pumping station. This pond will serve to store the run-off during periods of peak discharge, thereby decreasing the required pumping capacity. Consideration of the local topography led to the selection of Elevation 55 as the maximum pond level that would be permissible before damage due to flooding would begin.

G. RUN-OFF HYDROGRAPH. - Using the 10-year frequency rainfall curve for Chicopee as constructed from data by Yarnell (Rainfall Intensity - Frequency Data by D. L. Yarnell - Misc. Pub. #204 U.S.D. A.), a run-off hydrograph for a storm of 8-hour duration as shown on Plate 6 was developed in the following manner. The 10-year rainfall values were multiplied by an R.P.F. of 0.63, the weighted value for the total drainage area, to give the design rainfall values from which was constructed the hypothetical rain-graph shown on Plate 6. The following table gives the amounts of rainfall for various durations, as taken from the Yarnell data, and the corresponding design values.

	Amount of Rainfall in Inches for duration in hours.			
	1	2	4	5
Yarnell 10-year frequency	1.85	2.24	3.00	3.60
Design	1.17	1.40	1.88	2.27

The weighted value of the maximum peak-run-off-coefficient, 0.38, computed from the coefficients as given in the table under "E" above, was assumed to apply to those peaks in the rain-graph preceding the maximum peak. A time lag of one hour was obtained by approximate computation of the time of concentration, and the total amount of run-off to be considered in design was assumed to occur in 10 hours. The ratio of the total run-off in 10 hours to the total design eight-hour rainfall was estimated to be 0.53 as shown in the computation tabulated below:

Type	Area Acres	Total run-off coefficient	Area x coefficient
C_1	160	0.50	80.0
C_2	90	0.95	85.5
C_3	85	0.15	12.7
			178.2

Weighted value of total-run-off coefficient $= \frac{178.2}{335} = 0.53$.

The graph of storage capacity versus required pumping rate as shown on Plate 8 was derived from the run-off hydrograph.

V. REQUIRED DISCHARGE CAPACITY

V. REQUIRED DISCHARGE CAPACITY

A. PUMP CAPACITY REQUIRED.- The pumps will be required to discharge storm flow or dry-weather flow whenever the Connecticut River stage exceeds Elevation 47, which corresponds to less than 1-year frequency peak stage on the Connecticut River, after the 20-reservoir plan, and which is at present equalled or exceeded for a total of 44 days per average year as shown on the stage duration curve (Plate 7). The discharge values given in the table below are obtained from the studies explained under IV Hydrology.

Dry-weather flow	less than 1 c.f.s.
Maximum storm flow	100 c.f.s.
Top of dike	El. 72.7 m.s.l.
Connecticut River design flood stage	El. 67.4 m.s.l.
Normal intake water surface	El. 47.0 m.s.l.
Maximum intake water surface	El. 55.0 m.s.l.
Design maximum static head 67.4-47.0	20.4 ft.
10-year peak stage on Connecticut River (after 20-reservoir plan)	El. 57.0 m.s.l.

As shown on the storage capacity curve (Plate 8) 16.4 acre-feet of storage is available at Elevation 55 and the corresponding required pumping capacity is 35 c.f.s. Hence, the design pumping capacity, including flow from dike toe drains, is 40 c.f.s. at a static head of 10 feet (57.0-47.0).

B. INSTALLED PUMPING CAPACITY. - The installation will consist of two pumps having a capacity of 36 c.f.s. each. This provides sufficient capacity, with ample provisions for mechanical failure, to discharge the maximum design storm flow. The discharge capacity of the pumps will be less against the maximum static head of approximately 20 feet imposed by the Connecticut River design flood stage, Elevation 67.4 m.s.l. This design is considered conservative in view of the extremely rare probability of a peak stage on the Connecticut River being coincident with a maximum storm run-off from the local drainage area.

VII. STRUCTURAL DESIGN

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A. SPECIFICATIONS FOR STRUCTURAL DESIGN.

1. General. - The structural design of the Bertha Avenue pumping station has been executed in general in accordance with standard practice. The specifications which follow cover the conditions affecting the design of the reinforced concrete and structural steel.

2. Unit weights. - The following unit weights for material were assumed in the design of the structure:

Water	62.5 #	per cubic foot
Dry earth	100 #	" " "
Saturated earth	125 #	" " "
Concrete	150 #	" " "

3. Earth pressures. - For computing earth pressure caused by dry earth Rankine's formula was used. For saturated soils an equivalent liquid pressure of 80 pounds per square foot per foot of depth was assumed.

4. Structural steel. - The design of structural steel was carried out in accordance with the standard specifications for Steel Construction for Buildings of the American Institute of Steel Construction.

5. Reinforced concrete. - In general, all reinforced concrete was designed in accordance with the "Joint Committee on Standard Specifications for Concrete and Reinforced Concrete" issued in January 1937.

a. Allowable working stress. - The allowable working stress in concrete used in the design of the pump house structure and conduits is based on a compressive strength of 3,000 pounds per square inch in 28 days.

b. Flexure (f_c). -

	Lbs. per sq. in.
Extreme fibre stress in compression	800

b. Flexure (f_c). (Cont'd.)	Lbs. per sq. in.
Extreme fibre stress in compression adjacent to supports of continuous or fixed beams or rigid frames	900
c. Shear (v). -	
Beams with no web reinforcement and without special anchorage	60
Beams with no web reinforcement but with special anchorage of longitudinal steel	90
Beams with properly designed web reinforcement but without special anchorage of longitudinal steel	180
Beams with properly designed web reinforcement and with special anchorage of longitudinal steel	270
Footings where longitudinal bars have no special anchorage	60
Footings where longitudinal bars have special anchorage	90
d. Bond (u). -	
In beams, slabs, and one way footings	100
Where special anchorage is provided	200
The above stresses are for deformed bars.	
e. Bearing (f_c). -	
Where a concrete member has an area at least twice the area in bearing.	500

f. Axial compression (f_c). - Lbs. per sq. in.

Columns with lateral ties	450

g. Steel stresses. -

Tension	18000
Web reinforcement	16000

h. Protective concrete covering

Type of members	Minimum cover in inches
Interior slabs	1-1/2
Interior beams	2
Members poured directly against the ground	4
Members exposed to earth or water but poured against forms	3

For secondary steel, such as temperature and spacer steel, the above minimum cover may be decreased by the diameter of the temperature or spacer steel rods.

B. BASIC ASSUMPTIONS FOR DESIGN. -

1. Roof slab. - The roof slab is of reinforced concrete. It is designed to carry the full dead load plus a live load of 40# per square foot of roof surface.

2. Roof beams. - The roof beams are of structural steel encased in concrete fireproofing. They are designed to carry the full dead load, plus the full live load of 40# per square foot of roof surface. In addition to taking up the roof load, these beams, together with the columns to which they are connected, form portal frames which take up wind load and crane thrusts on the building. The end connections are designed to take up all such horizontal loads.

3. Columns. - a. Structural steel columns in the walls of the superstructure take up the direct roof loads as well as all wind loads on the superstructure. In addition, the columns in the side walls carry crane brackets which support the crane runway. These columns are designed to carry full live and dead load from the roof; dead load, live load and impact effect from the traveling crane; bending due to eccentrically applied loads, and bending due to wind load on the building. No point of inflection was considered in the column designed, a pin-ended condition at the base being assumed.

b. Columns other than the crane columns in the building designed for full dead load and live load from roof, plus wind load on the building.

c. Allowable stress in columns figured from formula

$$P/A = \frac{18000}{1 + \frac{l^2}{18000}}$$

With a maximum allowable stress of 15,000# per square inch for dead load plus live load, and a maximum allowable stress of 20,000# per square inch for combined dead load, live load and wind load; l/r limited not to exceed 120. loads are the estimated dead load plus a uniform load of 300# per square foot.

d. For the floor beams, the design loads are the estimated dead loads, the actual machinery loads, a concrete base slab load under the gasoline engine and right angle gear units, and a uniform load of 200# per square foot on the unoccupied portion of the floor slabs which contribute loads to the beams under consideration. For the machinery loads, an impact factor of 100 percent has been added.

4. Pump room, suction chamber and discharge conduit walk and slabs.

pump shafts will pass through an opening between the middle batten plates and will be supported sidewise by bearings bolted to the top batten plates. The steady beams will be bolted to the side walls with four 7/8 inch anchor bolts at each end. To obtain a firm bearing against the walls, the connection angles and bearing plate at one end of the beam will be shipped to the site loose with holes punched in the angles. Matching holes in each steady beam will be drilled in the field after each beam has been firmly shimmed against the walls. The steady beams are designed to take a side thrust of 1,000 pounds applied at the shaft bearing.

C. ARCHITECTURE. - The pumping station will be a building of modern design in keeping with the architectural treatment used on similar projects elsewhere on the Connecticut River. This design will give a pleasing appearance without undue emphasis being placed on purely decorative features.

The pumping station will be a flat-roofed, brick and glass block structure 25'6" x 25'6" overall. The 12.5 inch thick brick walls, capped with a cast stone coping, extend above the roof slab to form a parapet wall around the entire roof. A flat type roof was chosen as being economical and in keeping with the architectural design, as well as serving as a location for the engine exhaust mufflers. The roof system consists of steel beams encased in concrete and supported by steel columns. The roof slab will be 5 inches thick, covered with a cinder concrete fill sloped to drain. There are no outside pilasters. Inside the building there are pilasters at the chimney and at each structural steel column, the pilasters forming fire-proof column encasements. The engine room floor will be 6-inch structural concrete slab, with a monolithic finish.

a. Cement. - Cement will be tested by a recognized testing laboratory and results of these tests shall be known before the cement is used. True Portland Cement of a well known and acceptable brand will be used throughout.

b. Fine aggregate. - Natural sand will be used as a fine aggregate. The aggregate will be subject to thorough analysis, including magnesium sulphate soundness tests, and tests made on mortar specimens for compressive strength.

c. Coarse aggregate. - Marked gravel or crushed stone of required sizes will be used as coarse aggregate. It will consist of hard, tough and durable particles free from adherent coating and will be free from vegetable matter. Only a small amount of soft friable, thin or elongated particles will be allowed. The aggregate will be subject to accelerated freezing and thawing tests and to thorough analysis, including magnesium sulphate tests for soundness.

d. Water. - The amount of water used per bag of cement for each batch of concrete will be predetermined; in general, it will be the minimum amount necessary to produce a plastic mixture of the strength specified. Slump tests will be required in accordance with the specifications.

3. Field Control.

a. Storage. - The concrete components will be stored in a thoroughly dry, weather-tight and properly ventilated building. The fine and coarse aggregates will be stored in such a manner that inclusion of foreign material will be avoided.

IX. SUMMARY OF COST.

The total construction cost of the Bertha Avenue Pumping Station and mechanical equipment has been estimated to be $56,200, including 15 percent for engineering and 10 percent for contingencies.

This amount has been distributed as follows:

(1)	Pumping Station. -	
	a. Concrete features	$12,500
	b. Superstructure	7,000
	c. Miscellaneous	5,800
		$25,300
(2)	Mechanical equipment	30,900
	Total	$56,200

(1) a. The concrete features included under the pumping station Item (1) a. consist of intake structures, building foundation to and including operating floor structural slab, suction intake and gravity conduit.

(1) b. The superstructure consists of the complete building above the operating floor.

(1) c. Miscellaneous items are common excavation and backfill, miscellaneous iron and steel, trash racks, ramp, and other items not included in (1) a. and (1) b.

(2) The mechanical equipment consists of pumps, gasoline engines, gear units, crane, check valves, valves and piping, sluice gate system, and miscellaneous items.

ANALYSIS OF DESIGN

BERTHA AVENUE PUMPING STATION

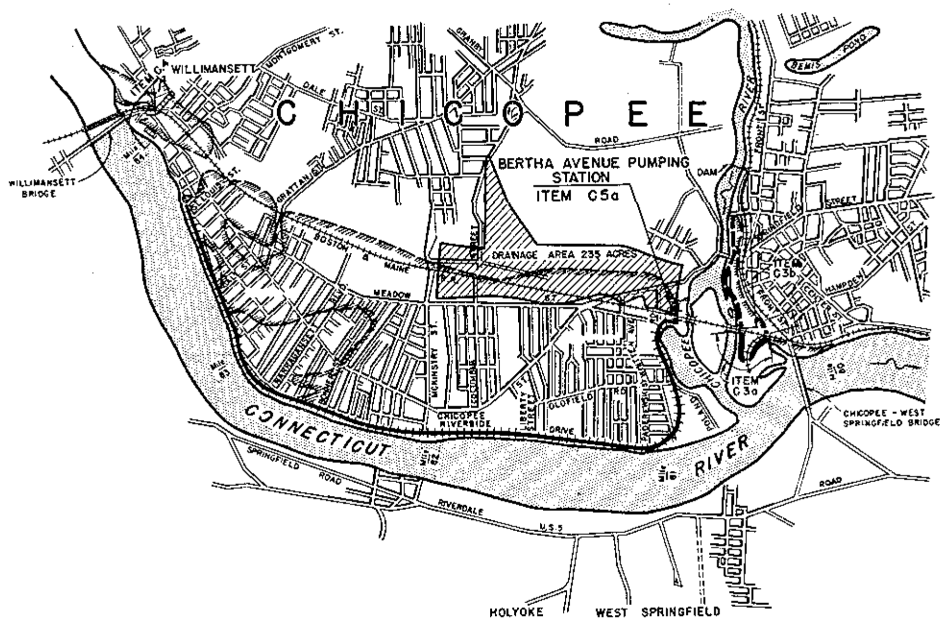
INDEX OF PLATES

WAR DEPARTMENT

CORPS OF ENGINEERS, U. S. ARMY

LOCATION MAP

SCALE 1"=8 MILES



VICINITY MAP

SCALE 1"=1500'

LEGEND

- Dikes completed Item C1 and C2.
- Item C.3a Fiscal Year 1940 Unit, West of B.&M.R.R. South Bank Chicopee River.
- Item C.3b Future Construction, Fiscal Year 1940 Unit, South Bank Chicopee River.
- Item C.4 Fiscal Year 1940 Section Willimansett Dike
- Overflow Limits, March 1936 flood.

KEY	DATE	REVISION (Indicated by Δ)	REV. BY	CK. BY	AP. BY
Δ	10/8/40	Sheet No 33 added.			

CONNECTICUT RIVER FLOOD CONTROL

BERTHA AVENUE PUMPING STATION

CHICOPEE, MASS.

PROJECT LOCATION AND INDEX

CONNECTICUT RIVER — MASSACHUSETTS

IN 33 SHEETS — SCALE: 1 IN. = 1500 FT. — SHEET NO. 1

1500' 0 1500' 3000'

U.S. ENGINEER OFFICE, PROVIDENCE, R.I., APRIL 1940

SUBMITTED: SENIOR ENGINEER, HEAD, DESIGN SECTION — APPROVAL RECOMMENDED: PRINCIPAL ENGINEER, CHIEF, F.C. ENGINEERING DIV. — APPROVED: LT. COL., CORPS OF ENGINEERS, DISTRICT ENGINEER

DESIGNED: P.C. Hanscomb, ASST. ENGINEER — DRAWN: W.S.G. TRACED: E.A.H. CHECKED: W.T.C.

FISCAL YEAR 1940

FILE NO. CT-4-2285

C.5a

PLATE NO. 1

WAR DEPARTMENT

CORPS OF ENGINEERS, U. S. ARMY

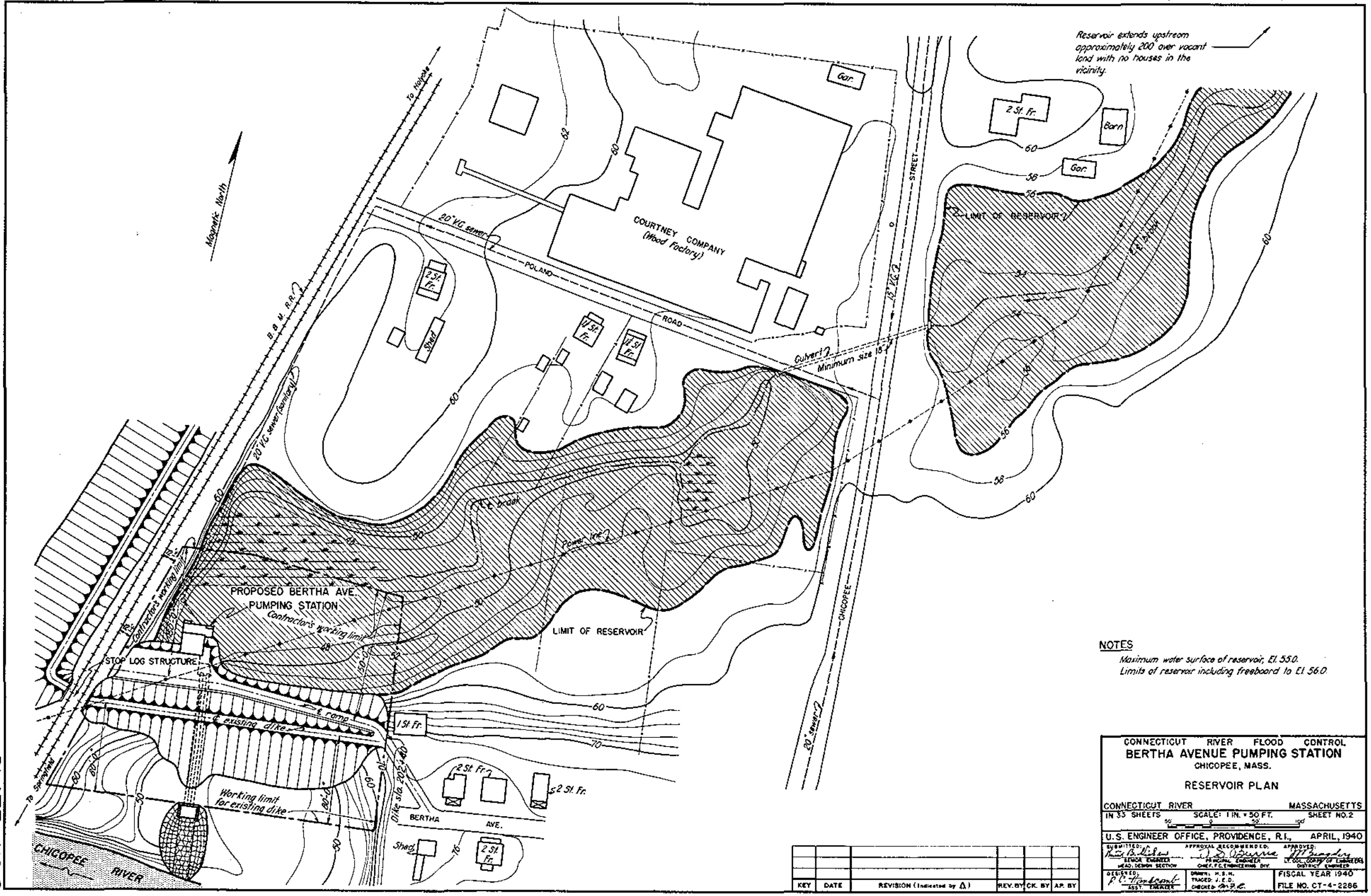
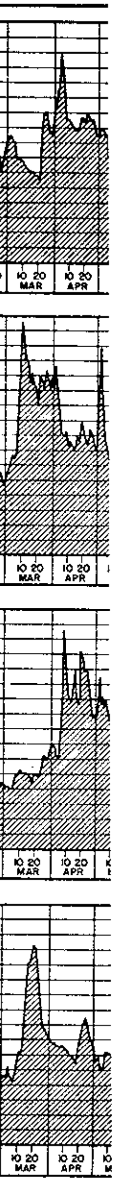


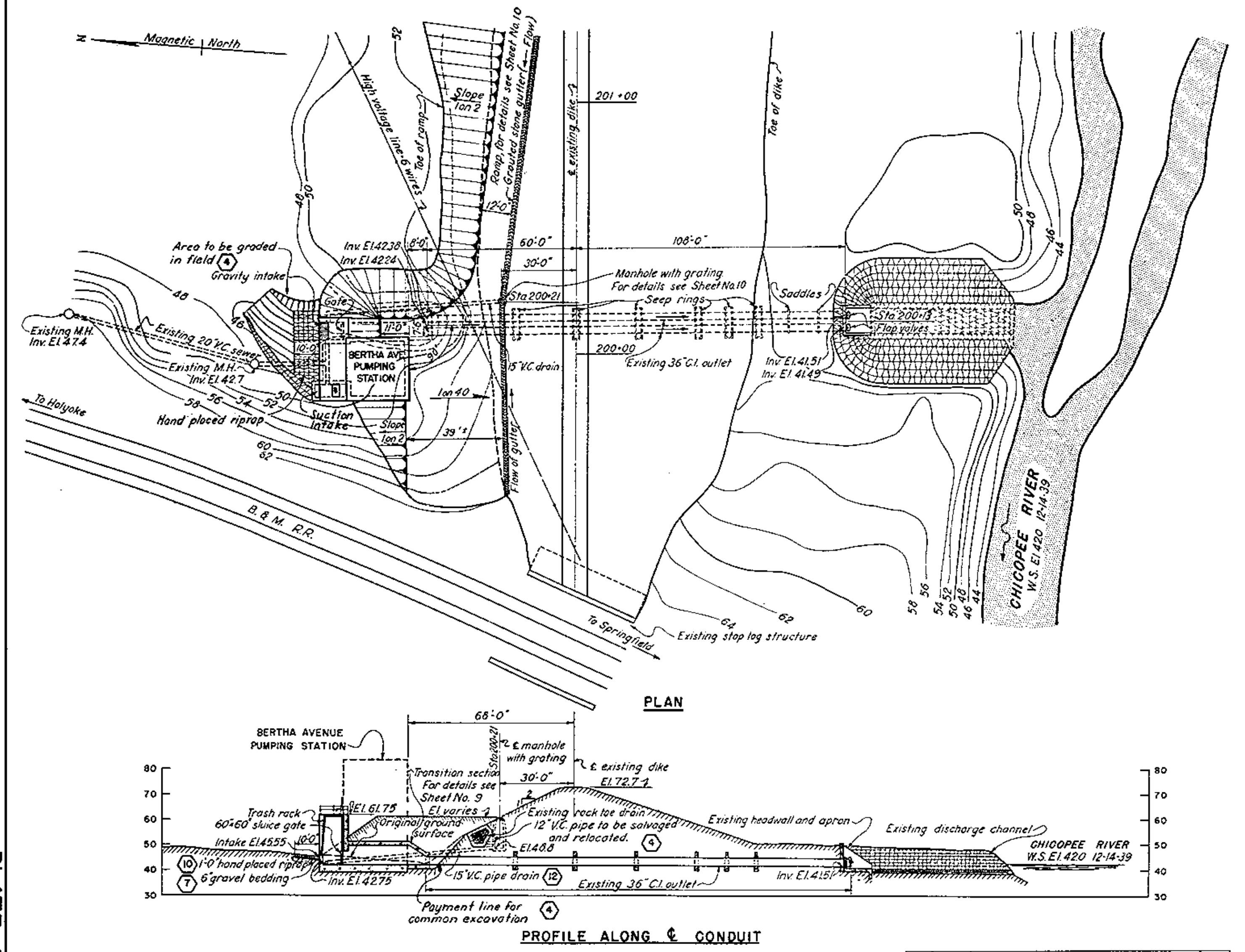
PLATE NO. 2

C.5a

WAR DEPARTMENT

CORPS OF ENGINEERS, U. S. ARMY





NOTE

Elevations refer to Mean Sea Level Datum.

CONNECTICUT RIVER FLOOD CONTROL
BERTHA AVENUE PUMPING STATION
CHICOPEE, MASS.
GENERAL PLAN

CONNECTICUT RIVER — MASSACHUSETTS
IN 33 SHEETS — SCALE: 1 IN.=20 FT. — SHEET NO. 3

U.S. ENGINEER OFFICE, PROVIDENCE, R.I., APRIL 1940

KEY	DATE	REVISION (Indicated by Δ)	REV. BY	CK. BY	AP. BY

SUBMITTED: Senior Engineer, Head, Design Section — APPROVAL RECOMMENDED: Principal Engineer, Chief, P.C. Engineering Div. — APPROVED: Lt. Col., Corps of Engineers, District Engineer

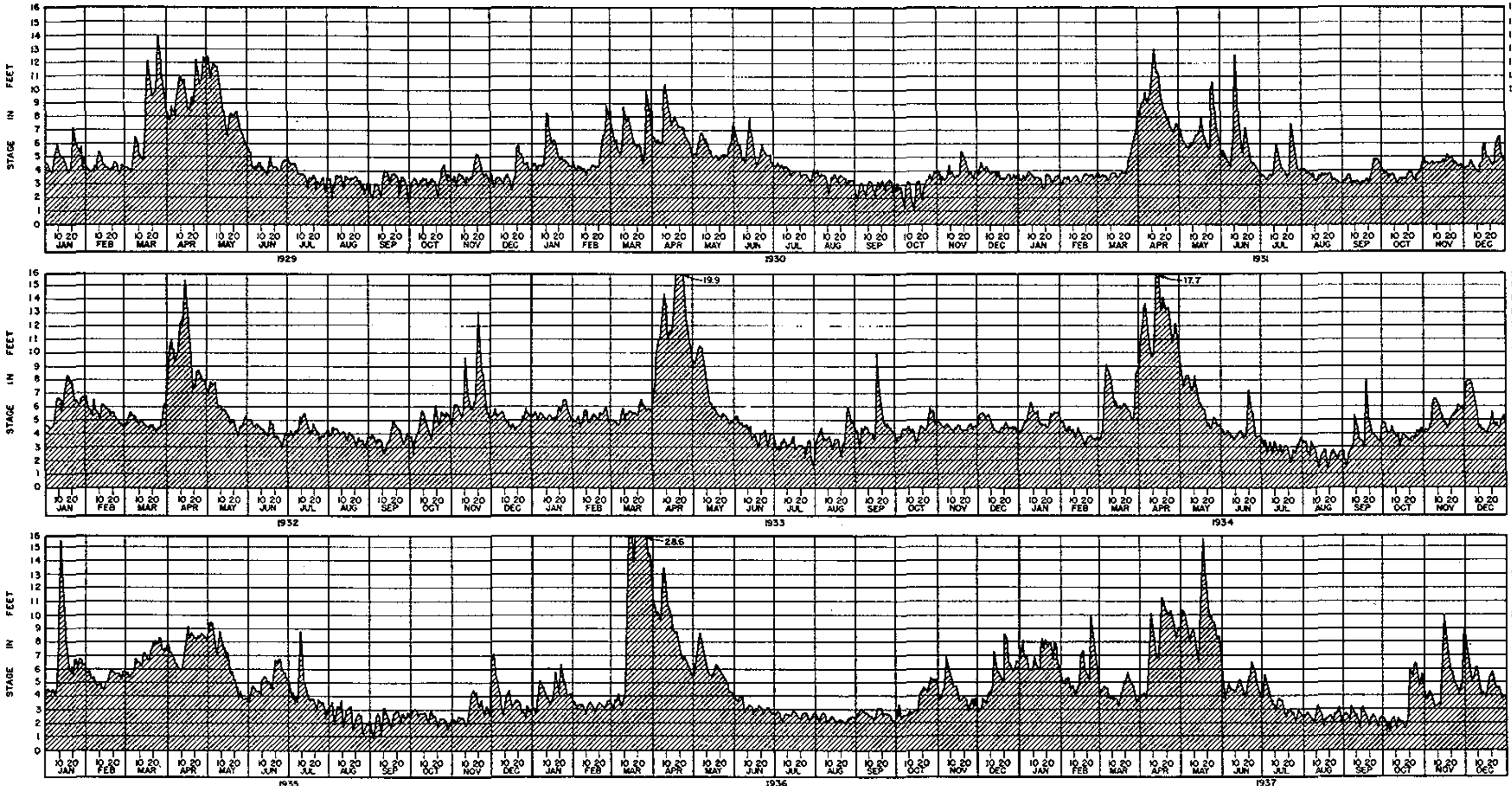
DESIGNED: Ass't. Engineer — FISCAL YEAR 1940 — FILE NO. CT-4-2287

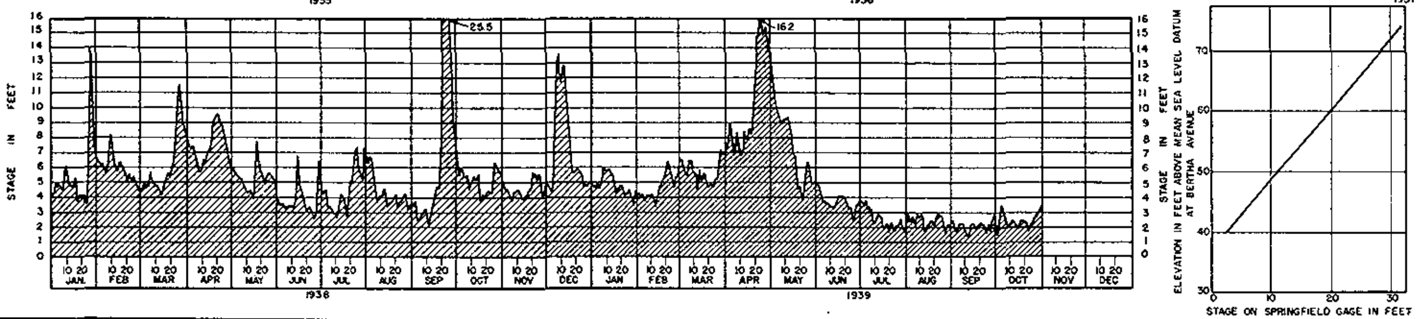
PLATE NO. 3

C5a

WAR DEPARTMENT

CORPS OF ENGINEERS, U. S. ARMY





NOTE

For notes pertaining to this sheet see Sheet No. 1 File No. CT-3-1164

KEY	DATE	REVISION (indicated by Δ)	REV. BY	CK. BY	AP. BY

CONNECTICUT RIVER FLOOD CONTROL

BERTHA AVENUE PUMPING STATION

CHICOPEE, MASS.

STAGE HYDROGRAPH NO. 2

CONNECTICUT RIVER — MASSACHUSETTS

IN 33 SHEETS — SCALE AS SHOWN — SHEET NO. 5

U. S. ENGINEER OFFICE, PROVIDENCE, R. I., APRIL, 1940

SUBMITTED: John B. [signature], ENGINEER, HD., HYDRAULICS SECTION

APPROVAL RECOMMENDED: [signature], PRINCIPAL ENGINEER, CHIEF F. C. ENGINEERING DIV.

APPROVED: [signature], LT. COL., CORPS OF ENGINEERS, DISTRICT ENGINEER

COMPILED: [signature], GEORGE ENGINEER

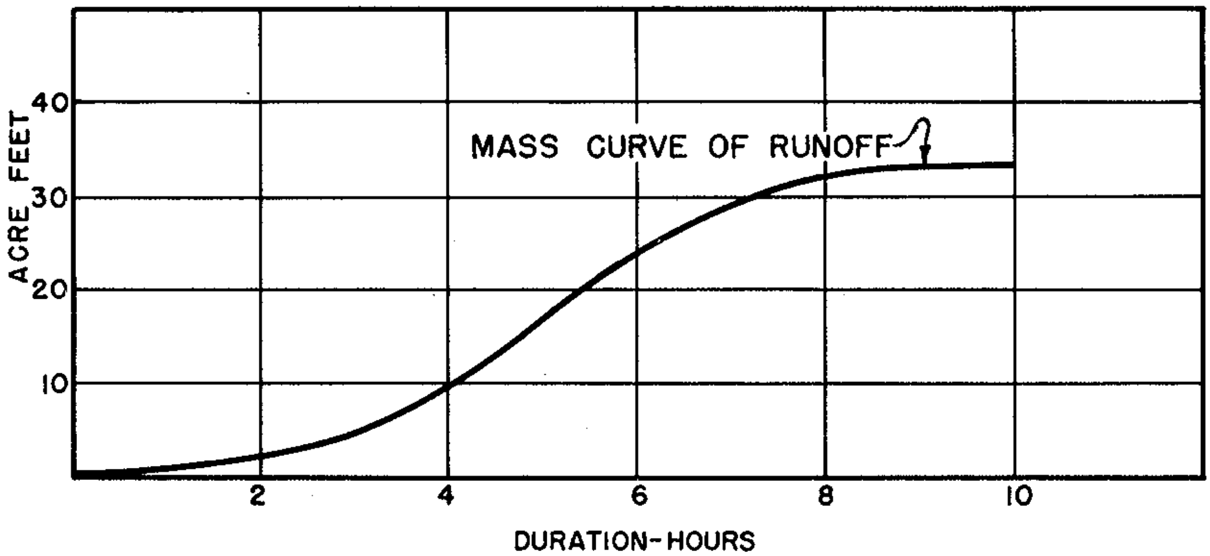
DRAWN: W.C.N. & G.A.L. TRACED: F.E.R. CHECKED: W.C.N.

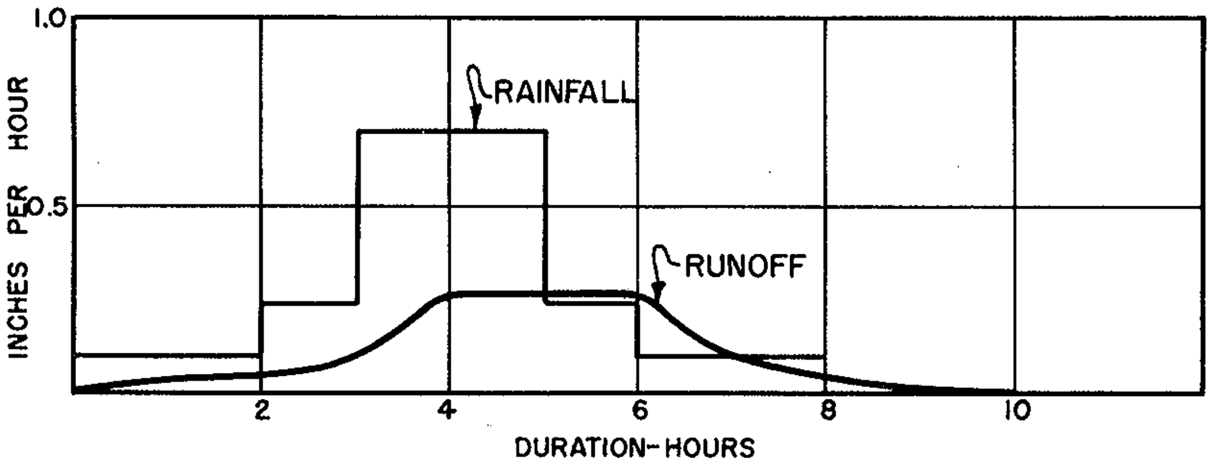
FISCAL YEAR 1940

FILE NO. CT-3-1165

G.5a

PLATE NO. 5





DRAINAGE AREA = 335 ACRES
TOTAL RAINFALL = 2.27"
TOTAL RUNOFF = 1.20" = 33.5 A.F.

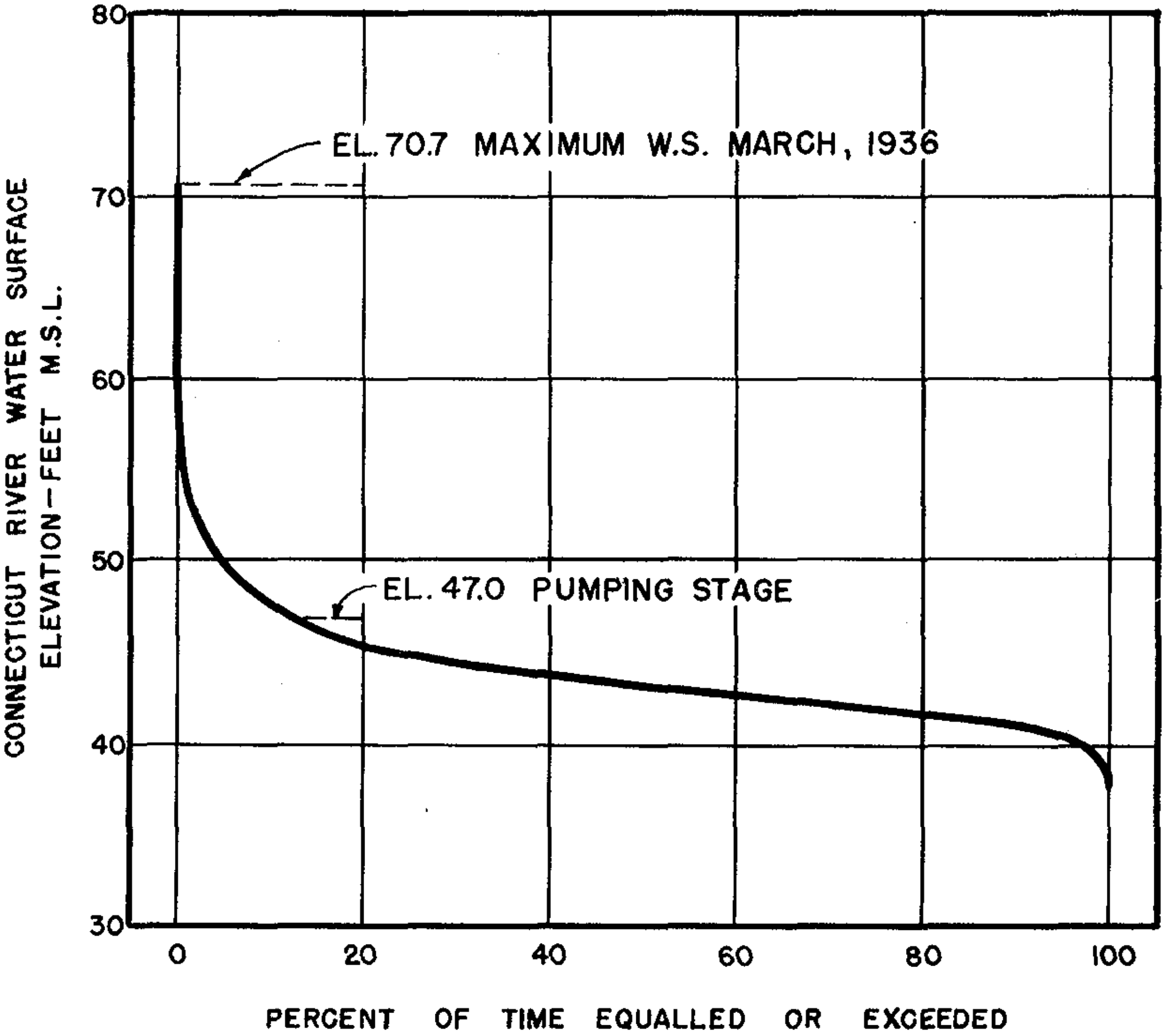
$$\frac{\text{TOTAL RUNOFF}}{\text{TOTAL RAINFALL}} = 0.53$$

BERTHA AVENUE PUMPING STATION

RUNOFF HYDROGRAPH

U.S. ENGINEER OFFICE, PROVIDENCE, R.I. APRIL 1940

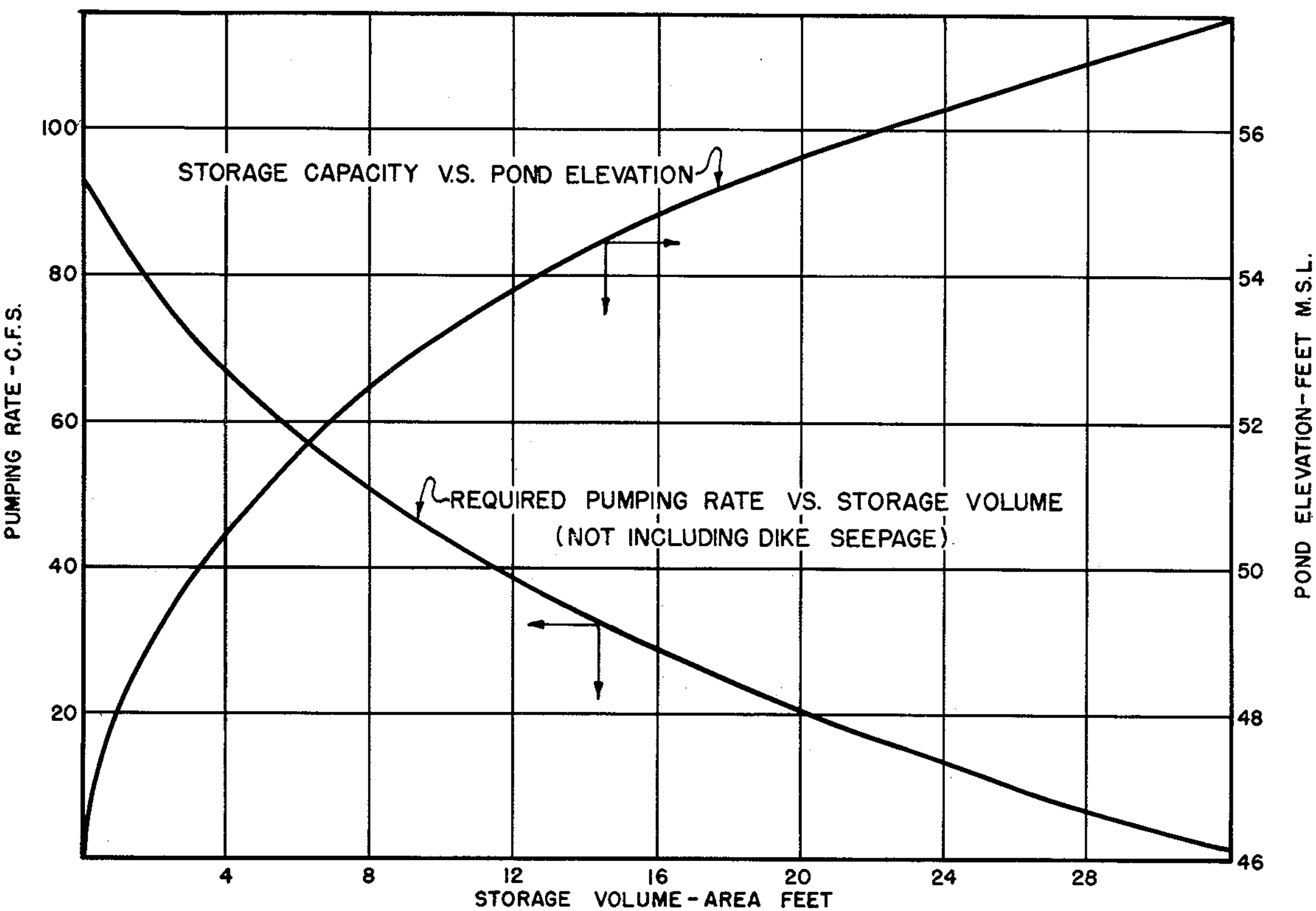
PLATE NO. 6



BERTHA AVENUE PUMPING STATION

STAGE DURATION CURVE

U.S. ENGINEER OFFICE, PROVIDENCE, R.I. APRIL 1940



BERTHA AVENUE PUMPING STATION

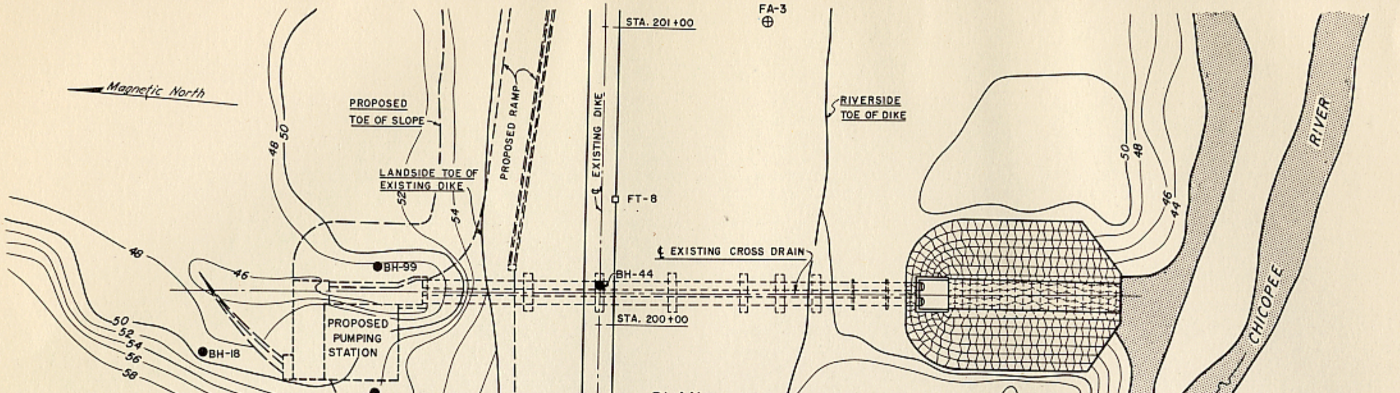
PUMPING RATE AND STORAGE CAPACITY

U.S. ENGINEER OFFICE, PROVIDENCE, R.I. APRIL 1940

PLATE NO. 8

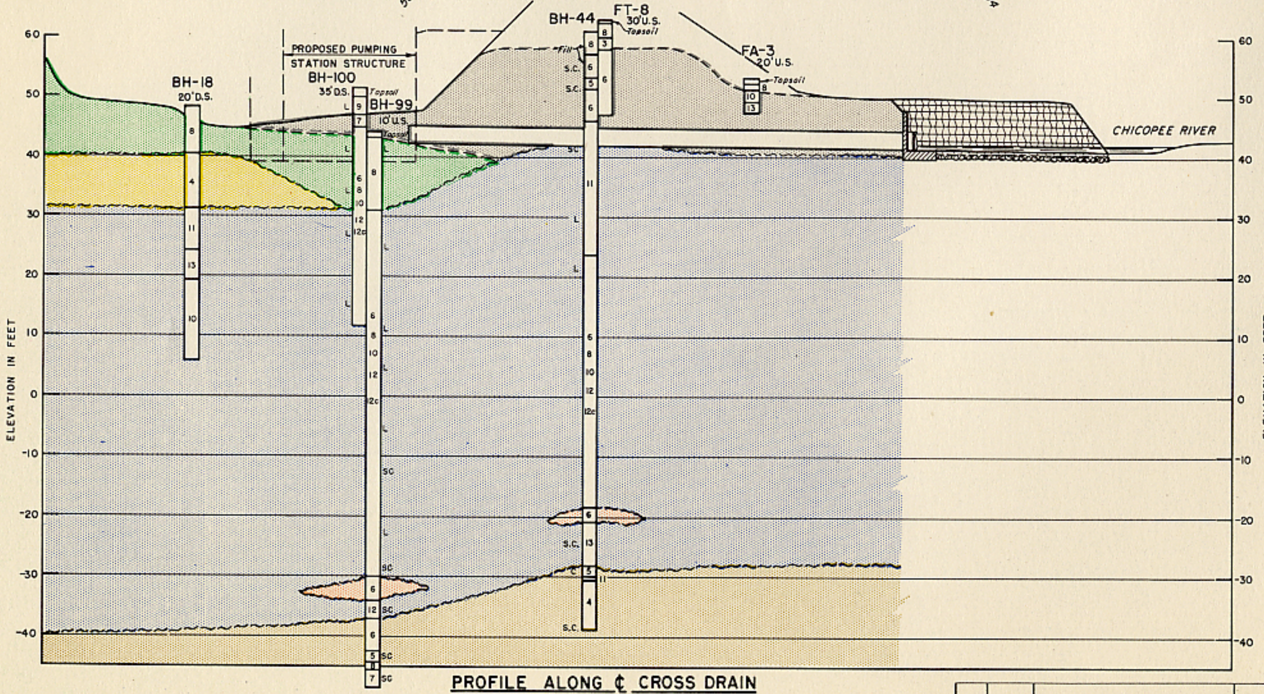
WAR DEPARTMENT

CORPS OF ENGINEERS, U. S. ARMY



PLAN

SCALE: 1" = 20'



PROFILE ALONG ℄ CROSS DRAIN

SCALE: HOR. 1" = 20' VERT. 1" = 10'

DESCRIPTION OF SOIL CLASSES

- 1 — Graded from Gravel to Coarse Sand - Contains little medium sand.
- 2 — Coarse to Medium Sand - Contains little gravel and fine sand.
- 3 — Graded from Gravel to Medium Sand - Contains little fine sand.
- 4 — Medium to Fine Sand - Contains little coarse sand and coarse silt.
- 5 — Graded from Gravel to Fine Sand - Contains little coarse silt.
- 6 — Fine Sand to Coarse Silt - Contains little medium sand and medium silt.
- 7 — Graded from Gravel to Coarse Silt - Contains little medium silt.
- 8 — Coarse to Medium Silt - Contains little fine sand and fine silt.
- 9 — Graded from Gravel to Medium Silt - Contains little fine silt.
- 10 — Medium to Fine Silt - Contains little coarse silt and coarse clay. Possesses behavior characteristics of silt.
- 10C — Medium Silt to Coarse Clay - Contains little coarse silt and medium clay. Possesses behavior characteristics of clay.
- 11 — Graded from Gravel or Coarse Sand to Fine Silt - Contains little coarse clay.
- 12 — Fine Silt to Clay - Contains little medium silt and fine clay (colloids). Possesses behavior characteristics of silt.
- 12C — Clay - Contains little silt. Possesses behavior characteristics of clay.
- 13 — Graded from Coarse Sand to Clay - Contains little fine clay (colloids). Possesses behavior characteristics of silt.
- 13C — Clay - Graded from sand to fine clay (colloids) Possesses behavior characteristics of clay.

LEGEND

- L — *Loose material*
- SC — *Slightly compact material*
- C — *Compact material*
- VC — *Very compact material*
- ● BH - *Drive sample bore hole*
- ⊕ FA - *Foundation auger boring*
- ☐ FT - *Foundation test pit*
- U.S. - *Upstream of cross drain*
- D.S. - *Downstream of cross drain*

NOTES

Proposed construction shown by heavy broken line.

Classes 6, 8, 10, 12 & 12C indicated in bore hole records generally occur in alternating bands, having thin layers of fine clay interbedded with thicker layers of silt or fine sand.

Samples, test results, and logs pertaining to the materials from the bore holes are available for inspection by interested parties at the United States Engineer Office, Providence, R.I.

Elevations refer to Mean Sea Level Datum.

For color key see Plate No. 11.

KEY	DATE	REVISION (Indicated by Δ)	REV. BY	CK. BY	AP. BY

CONNECTICUT RIVER FLOOD CONTROL

BERTHA AVENUE PUMPING STATION

CHICOPEE MASS.

SUBSURFACE EXPLORATIONS

CONNECTICUT RIVER — MASSACHUSETTS

IN 33 SHEETS — SCALE: 1 IN = 20 FT. (20' 0 20' 40') — SHEET NO. 6

U.S. ENGINEER OFFICE, PROVIDENCE, R.I., APRIL 1940

SUBMITTED: SENIOR GEOLOGIST, HEAD, GEOLOGY SECTION

APPROVAL RECOMMENDED: PRINCIPAL ENGINEER, CHIEF, F.C. ENGINEERING DIV.

APPROVED: LT. COL., CORPS OF ENGINEERS, DISTRICT ENGINEER

COMPILED: ASST. ENGINEER

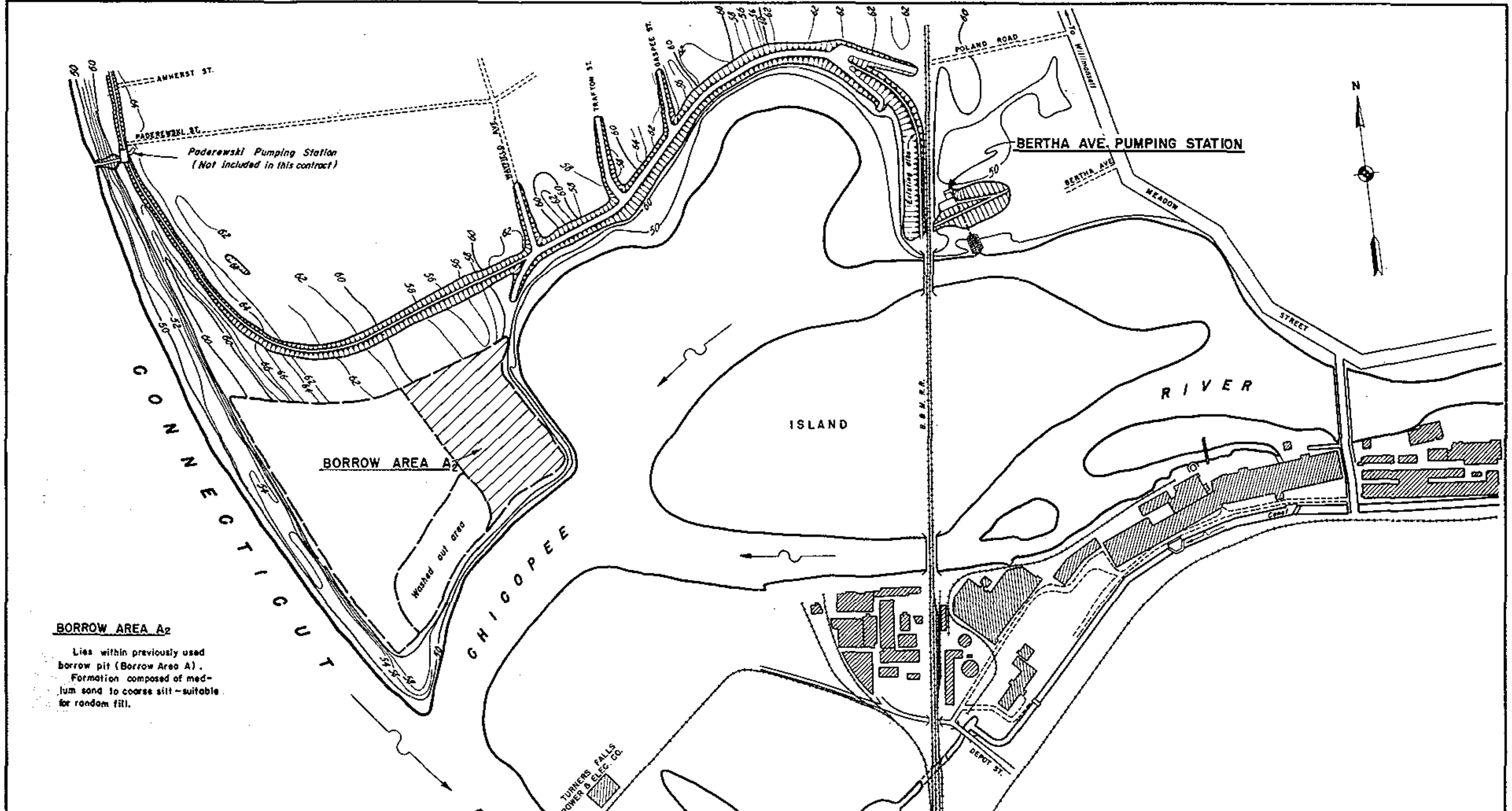
DRAWN: J. McL. TRACED: C. J. M. CHECKED: W. a. d. jr.

FISCAL YEAR 1940

FILE NO. CT-2-1261

C. 5a

PLATE NO. 9



BORROW AREA A_2

Lies within previously used borrow pit (Borrow Area A). Formation composed of medium sand to coarse silt – suitable for random fill.

KEY	DATE	REVISION (Indicated by Δ)	REV. BY	CK. BY	AP. BY

CONNECTICUT RIVER FLOOD CONTROL
BERTHA AVENUE PUMPING STATION
CHICOPEE, MASS.

BORROW AREA

CONNECTICUT RIVER — MASSACHUSETTS
IN 33 SHEETS — SCALE: 1 IN. = 200 FT. — SHEET NO. 7
U. S. ENGINEER OFFICE, PROVIDENCE, R.I., APRIL, 1940
SUBMITTED: SENIOR GEOLOGIST, HEAD, GEOLOGY SECTION — APPROVAL RECOMMENDED: PRINCIPAL ENGINEER, CHIEF, F.C. ENGINEERING DIV. — APPROVED: LT. COL., CORPS OF ENGINEERS, DISTRICT ENGINEER
COMPILED: ASST. ENGINEER — DRAWN: F.X.F. TRACED: M.N. CHECKED
FISCAL YEAR 1940
FILE NO. CT-2-1262

PLATE NO. 10

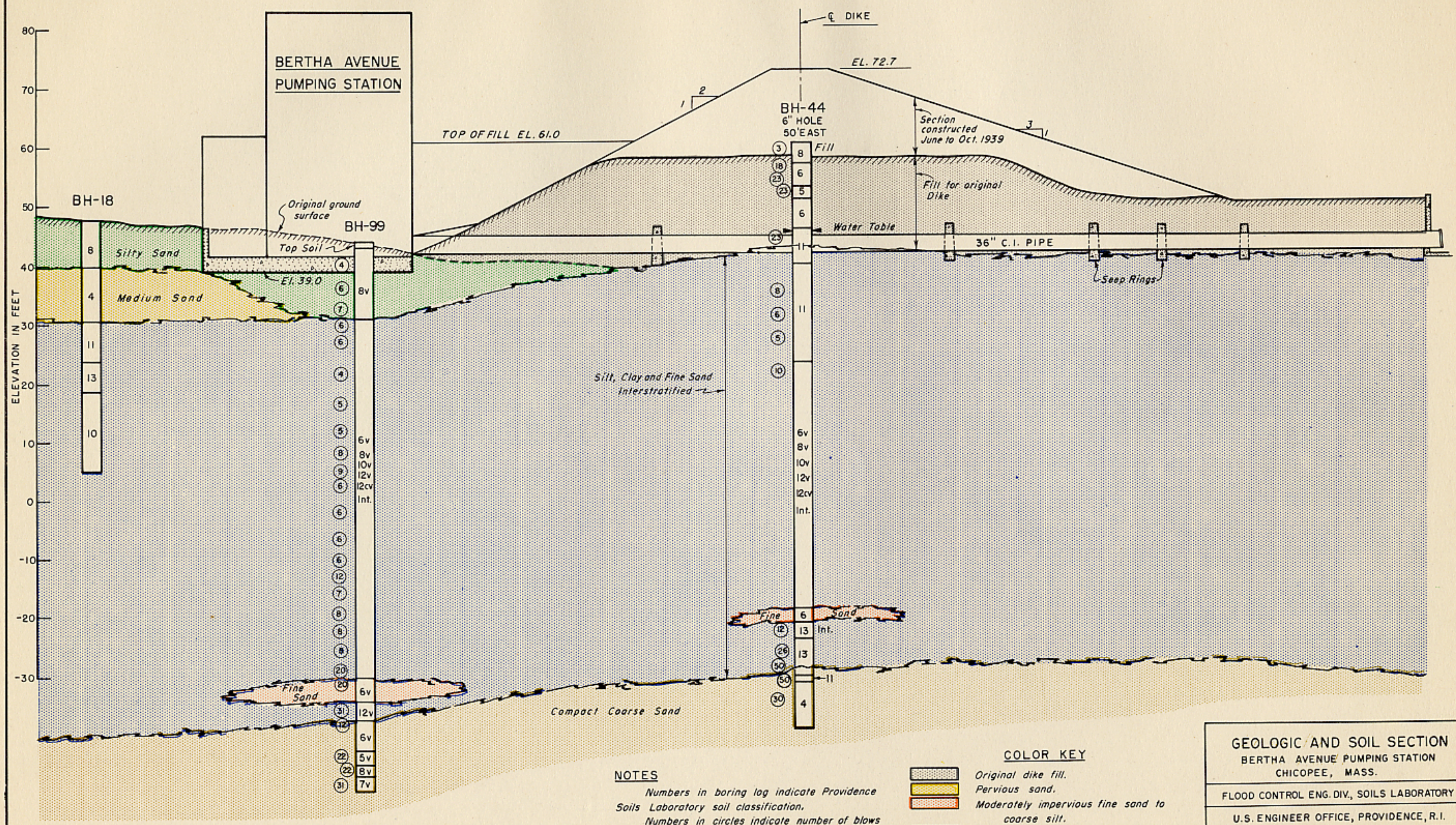


PLATE NO. 11

NOTES

Numbers in boring log indicate Providence Soils Laboratory soil classification.

Numbers in circles indicate number of blows required to drive a 2" O.D. sample spoon one foot with a 300 pound hammer dropped 18 inches.

COLOR KEY

- Original dike fill.
- Pervious sand.
- Moderately impervious fine sand to coarse silt.
- Impervious varved clay.
- Impervious silt with some fine sand and clay.
- Hardpan – gravel, sand, and silt mixture.

GEOLOGIC AND SOIL SECTION

BERTHA AVENUE PUMPING STATION
CHICOPEE, MASS.

FLOOD CONTROL ENG. DIV., SOILS LABORATORY

U.S. ENGINEER OFFICE, PROVIDENCE, R.I.

SUBMITTED BY W.I.K.	SCALE: 1 IN. = 10 FT.
ANALYSIS BY R.A.B.	
DRAWN BY H.M.	S.L. NO. C.5a – A1d
DATE: MARCH 29, 1940	PLATE NO. 11

PROVIDENCE DISTRICT SOIL CLASSIFICATION

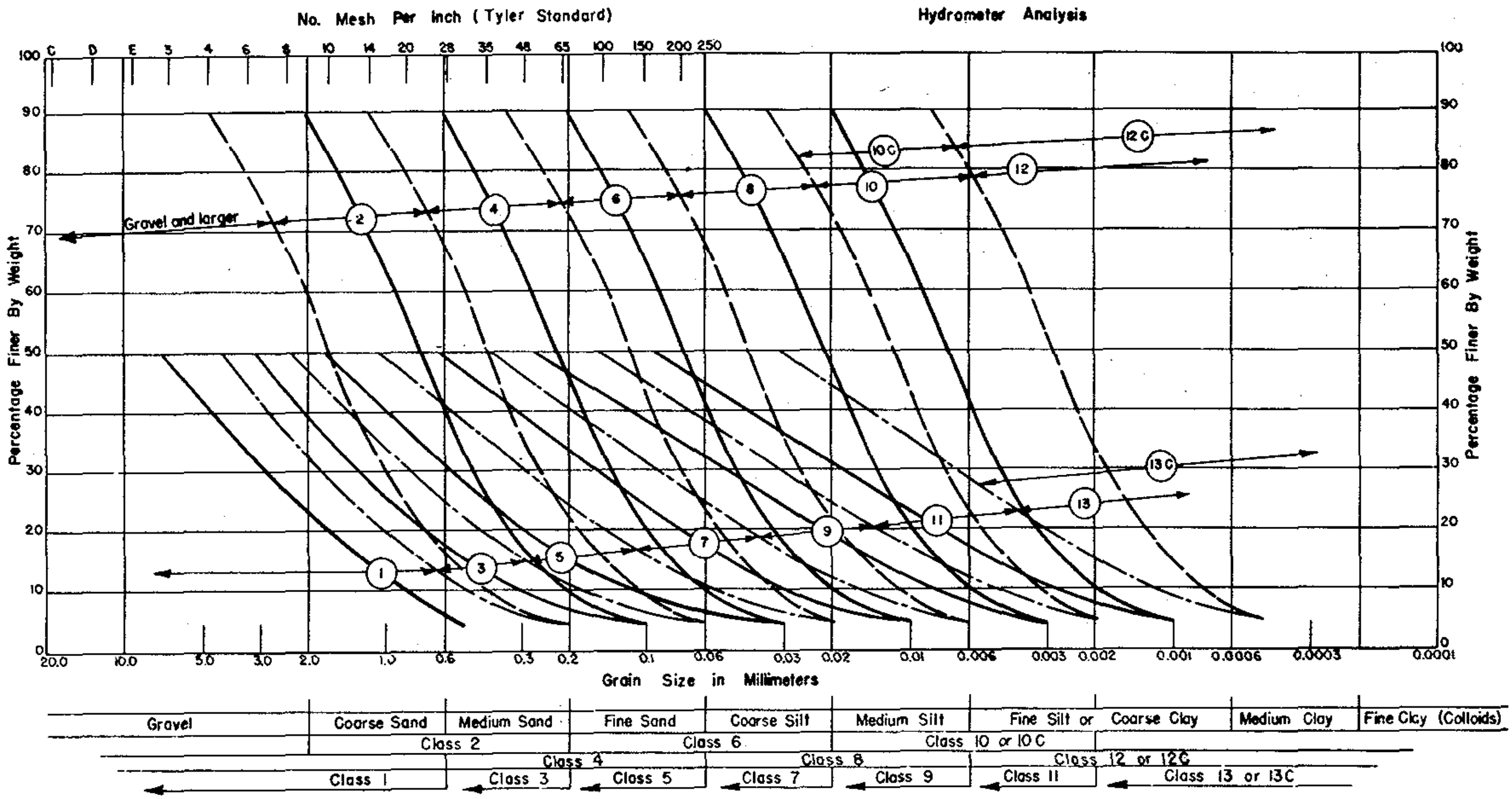
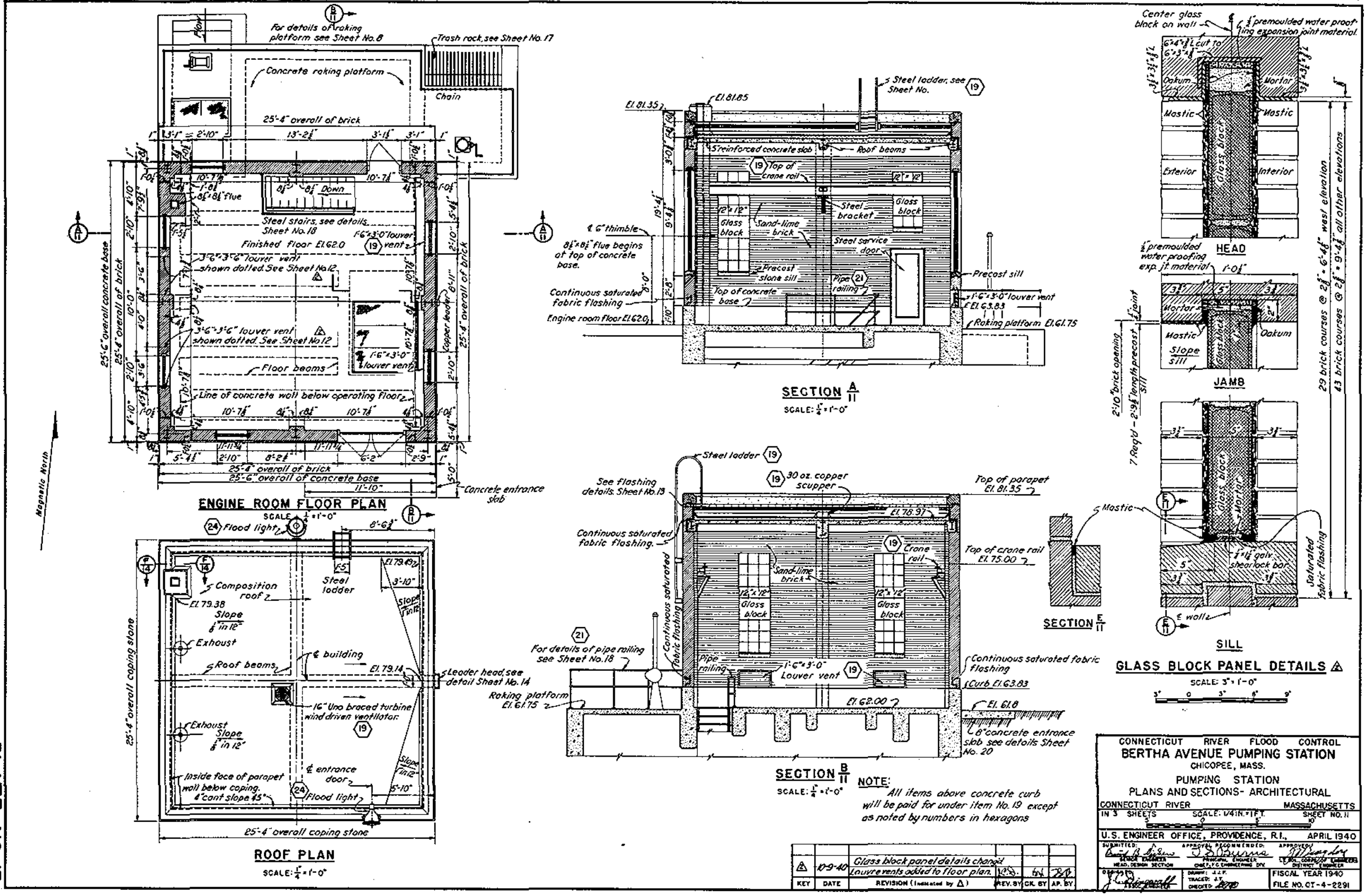


DIAGRAM SHOWING LIMITS OF SOIL CLASSES

PLATE NO. 12

WAR DEPARTMENT

CORPS OF ENGINEERS, U. S. ARMY



KEY	DATE	REVISION (Indicated by △)	REV. BY	CK. BY	AP. BY
△	10-9-40	Glass block panel details changed. Louvre vents added to floor plan.			

CONNECTICUT RIVER FLOOD CONTROL
BERTHA AVENUE PUMPING STATION
CHICOPEE, MASS.
PUMPING STATION
PLANS AND SECTIONS - ARCHITECTURAL

CONNECTICUT RIVER — MASSACHUSETTS
IN 3 SHEETS — SCALE: 1/4 IN. = 1 FT. — SHEET NO. 11

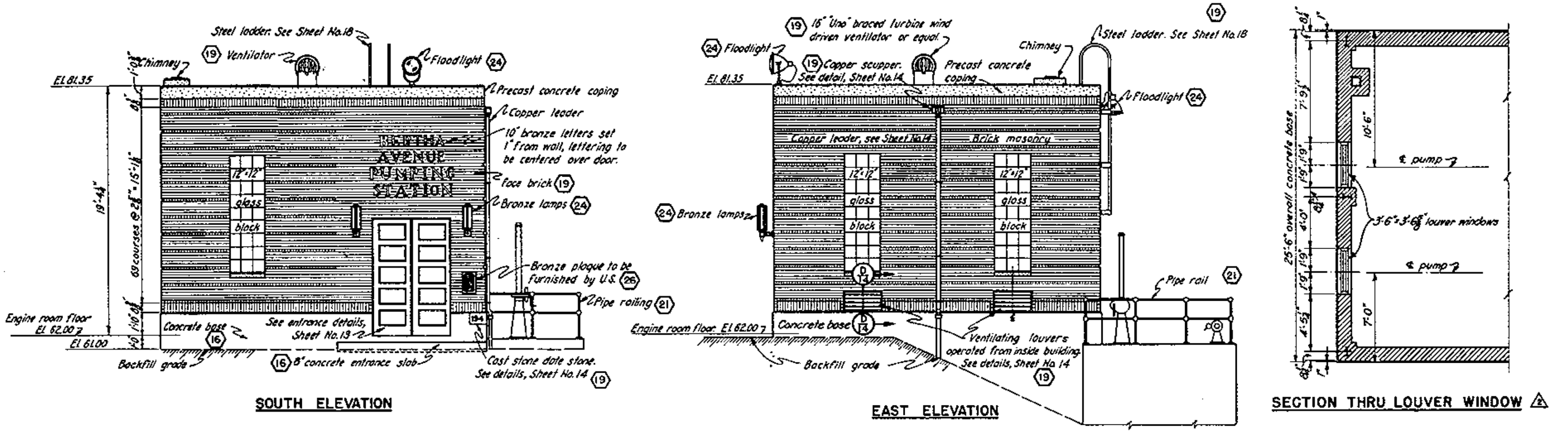
U.S. ENGINEER OFFICE, PROVIDENCE, R.I. — APRIL 1940

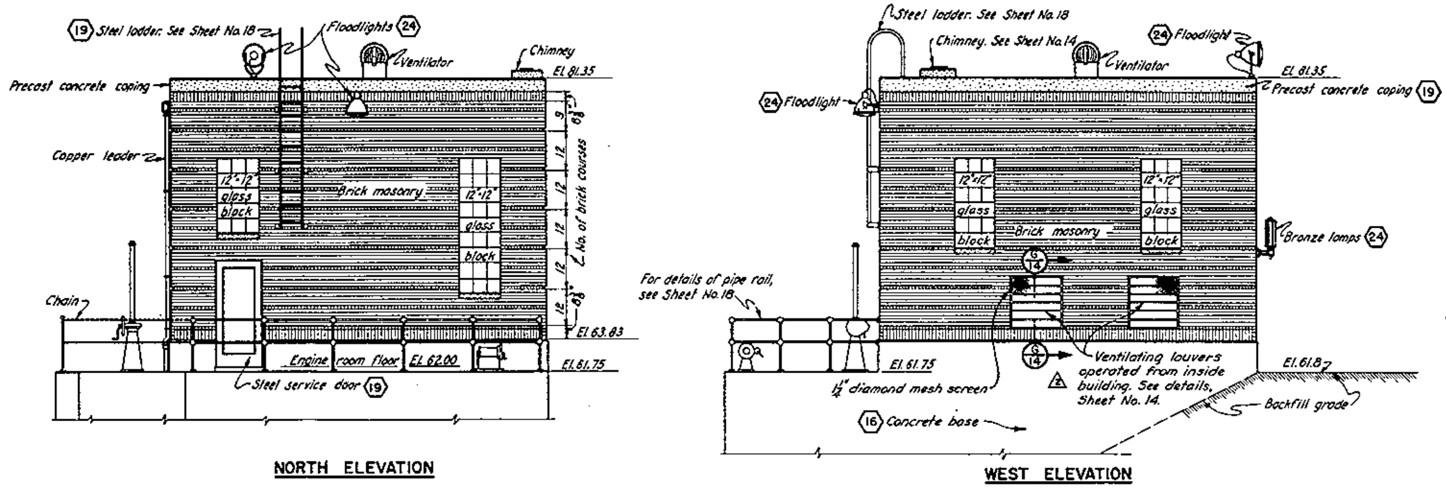
SUBMITTED: SENIOR ENGINEER, HEAD, DESIGN SECTION — APPROVAL RECOMMENDED: PRINCIPAL ENGINEER, CHIEF, F.C. ENGINEERING DIV. — APPROVED: LT. COL. CORPS OF ENGINEERS, DISTRICT ENGINEER

FISCAL YEAR 1940
FILE NO. CT-4-2291

PLATE NO. 13

C.5a





NOTES

All items above concrete curb will be paid for under Item No. 19 except as noted by numbers in hexagons.

All vertical brick dimensions are from bottom of brick joint to bottom of brick joint unless otherwise noted.

Brick dimensions are based on standard brick $2\frac{1}{4}" \times 3\frac{3}{4}" \times 8"$ with $\frac{3}{8}"$ joint.

For electric circuits and fixtures see Sheet No. 32.

KEY	DATE	REVISION (Indicated by △)	REV. BY	CK. BY	AP. BY
△	10-9-40	Windows changed - louvres added			

CONNECTICUT RIVER FLOOD CONTROL
BERTHA AVENUE PUMPING STATION
CHICOPEE, MASS.
PUMPING STATION
ELEVATIONS - ARCHITECTURAL

CONNECTICUT RIVER — MASSACHUSETTS
IN 33 SHEETS — SCALE: 1/4 IN. = 1 FT. — SHEET NO. 12

U.S. ENGINEER OFFICE, PROVIDENCE, R.I. — APRIL 1940

SUBMITTED: HEAD, DESIGN SECTION — APPROVAL RECOMMENDED: PRINCIPAL ENGINEER, CHIEF, F.C. ENGINEERING DIV. — APPROVED: LT. COL., CORPS OF ENGINEERS, DISTRICT ENGINEER

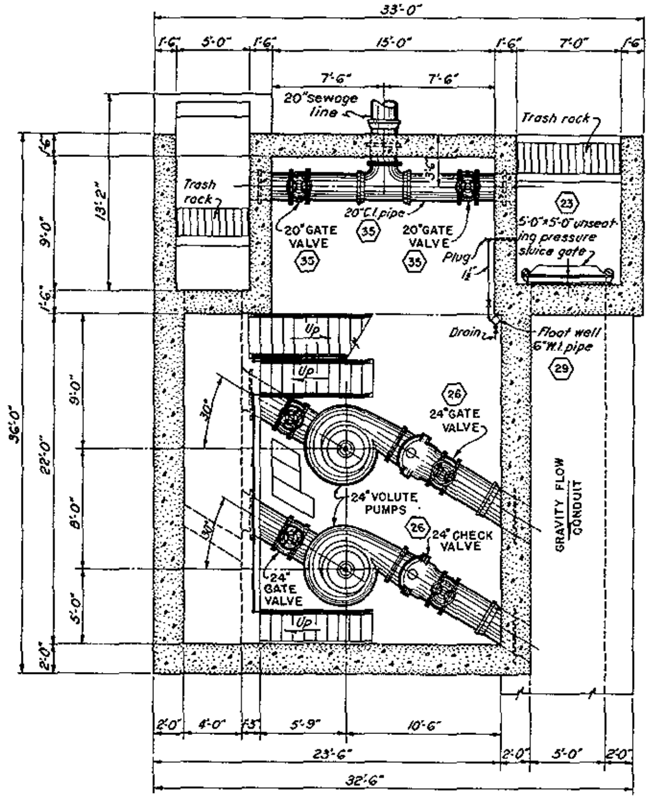
DESIGNED: — DRAWN: — TRACED: — CHECKED:

FISCAL YEAR 1940
FILE NO. CT-4-2292

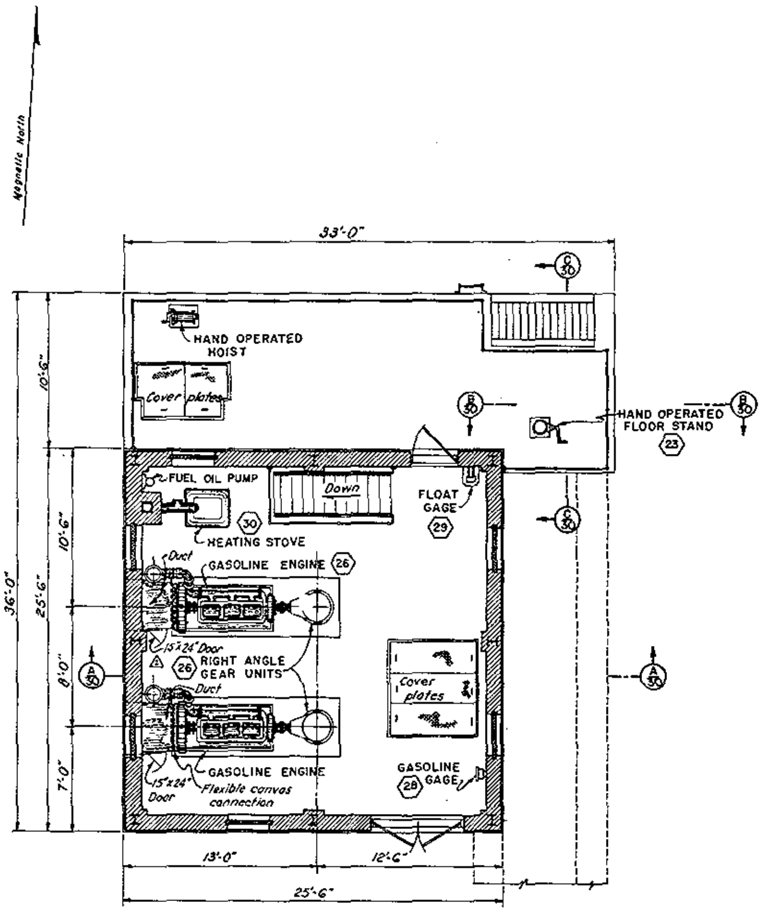
C.5a

WAR DEPARTMENT

CORPS OF ENGINEERS, U. S. ARMY



PUMP ROOM PLAN



ENGINE ROOM PLAN

PLATE NO. 15

KEY	DATE	REVISION (indicated by Δ)	REV. BY	CK. BY	AP. BY
Δ	10-9-40	Addition of Ducts and Louvers	[illegible]	[illegible]	[illegible]

CONNECTICUT RIVER FLOOD CONTROL

BERTHA AVENUE PUMPING STATION

CHICOPEE, MASS.

GENERAL ARRANGEMENT OF EQUIPMENT

CONNECTICUT RIVER — MASSACHUSETTS

IN 33 SHEETS — SCALE: 1/4 IN. = 1 FT. — SHEET NO. 29

U.S. ENGINEER OFFICE, PROVIDENCE, R.I., APRIL, 1940

SUBMITTED: SENIOR ENGINEER, HEAD, DESIGN SECTION — APPROVAL RECOMMENDED: PRINCIPAL ENGINEER, CHIEF, F.C. ENGINEERING DIV. — APPROVED: LT. COL., CORPS OF ENGINEERS, DISTRICT ENGINEER

DESIGNED: — DRAWN: — TRACED: — CHECKED:

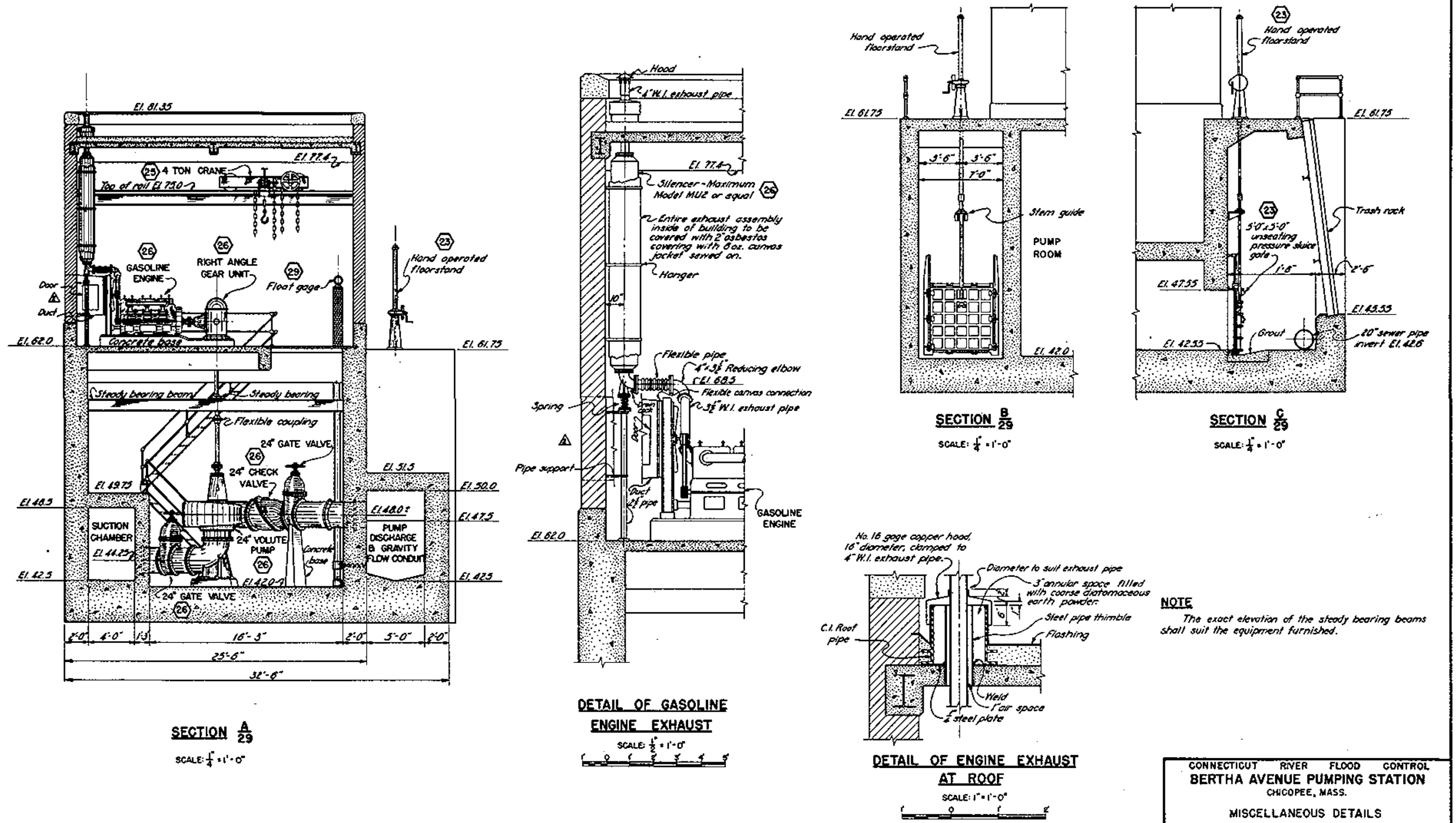
FISCAL YEAR 1940

FILE NO. CT-4-2309

C.5a

WAR DEPARTMENT

CORPS OF ENGINEERS, U. S. ARMY



NOTE

The exact elevation of the steady bearing beams shall suit the equipment furnished.

KEY	DATE	REVISION (Indicated by △)	REV. BY	CK. BY	AP. BY
△	10-3-40	Addition of Ducts and Louvers			

CONNECTICUT RIVER FLOOD CONTROL
BERTHA AVENUE PUMPING STATION
CHICOPEE, MASS.

MISCELLANEOUS DETAILS

CONNECTICUT RIVER — MASSACHUSETTS
IN 33 SHEETS — SCALE: 1/4 IN. = 1 FT. — SHEET NO. 30

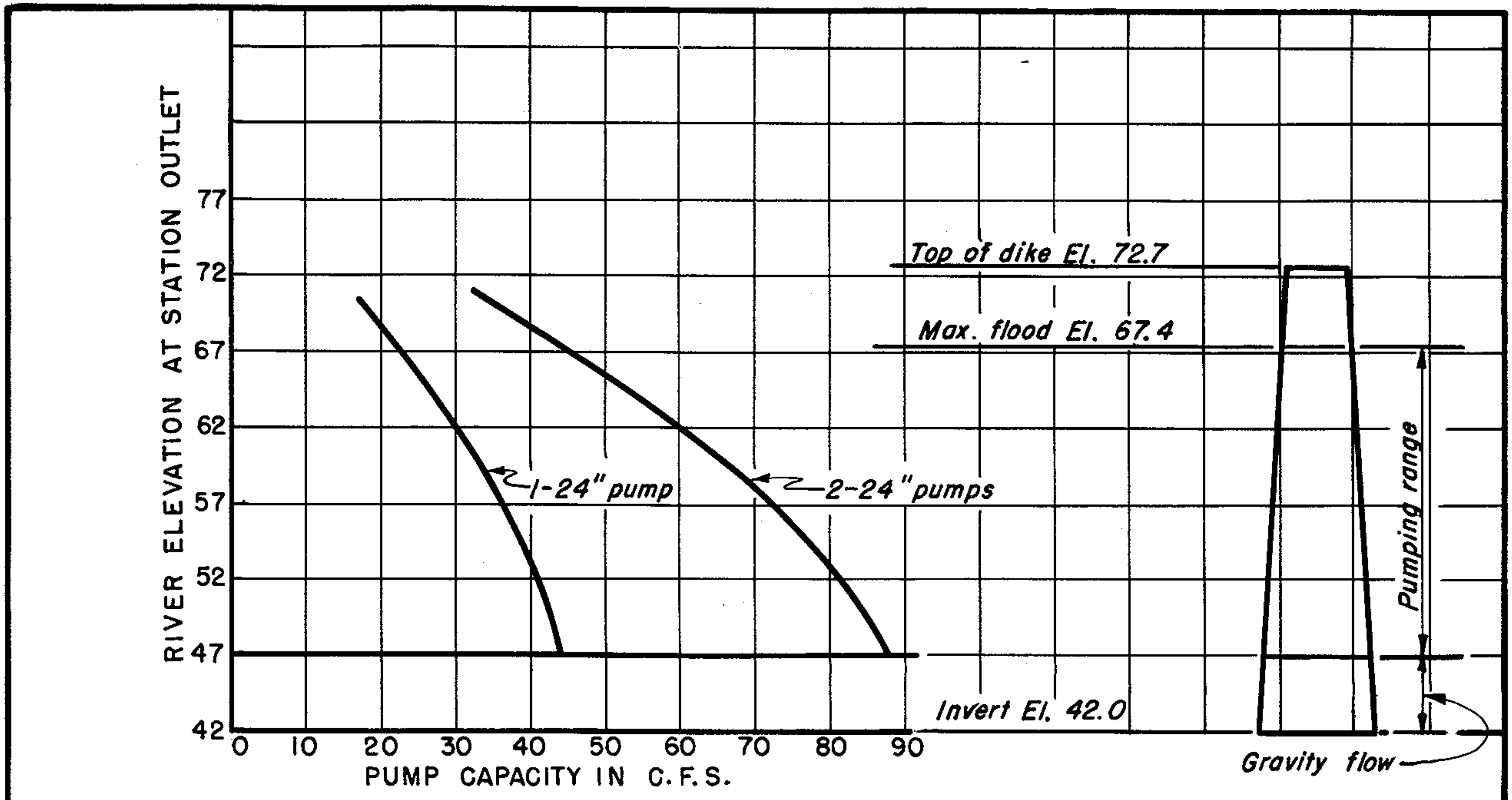
U. S. ENGINEER OFFICE, PROVIDENCE, R.I., APRIL, 1940

SUBMITTED: HEAD, DESIGN SECTION — APPROVAL RECOMMENDED: CHIEF, F.C. ENGINEERING DIV. — APPROVED: DISTRICT ENGINEER

DESIGNED: — DRAWN: — TRACED: — CHECKED: — FISCAL YEAR 1940 — FILE NO. CT-4-2310

C.5a

PLATE NO. 16



CONNECTICUT RIVER FLOOD CONTROL

BERTHA AVE. PUMPING STATION

PUMPING CAPACITY

U.S. ENGINEER OFFICE PROVIDENCE, R. I.

PLATE NO. 17

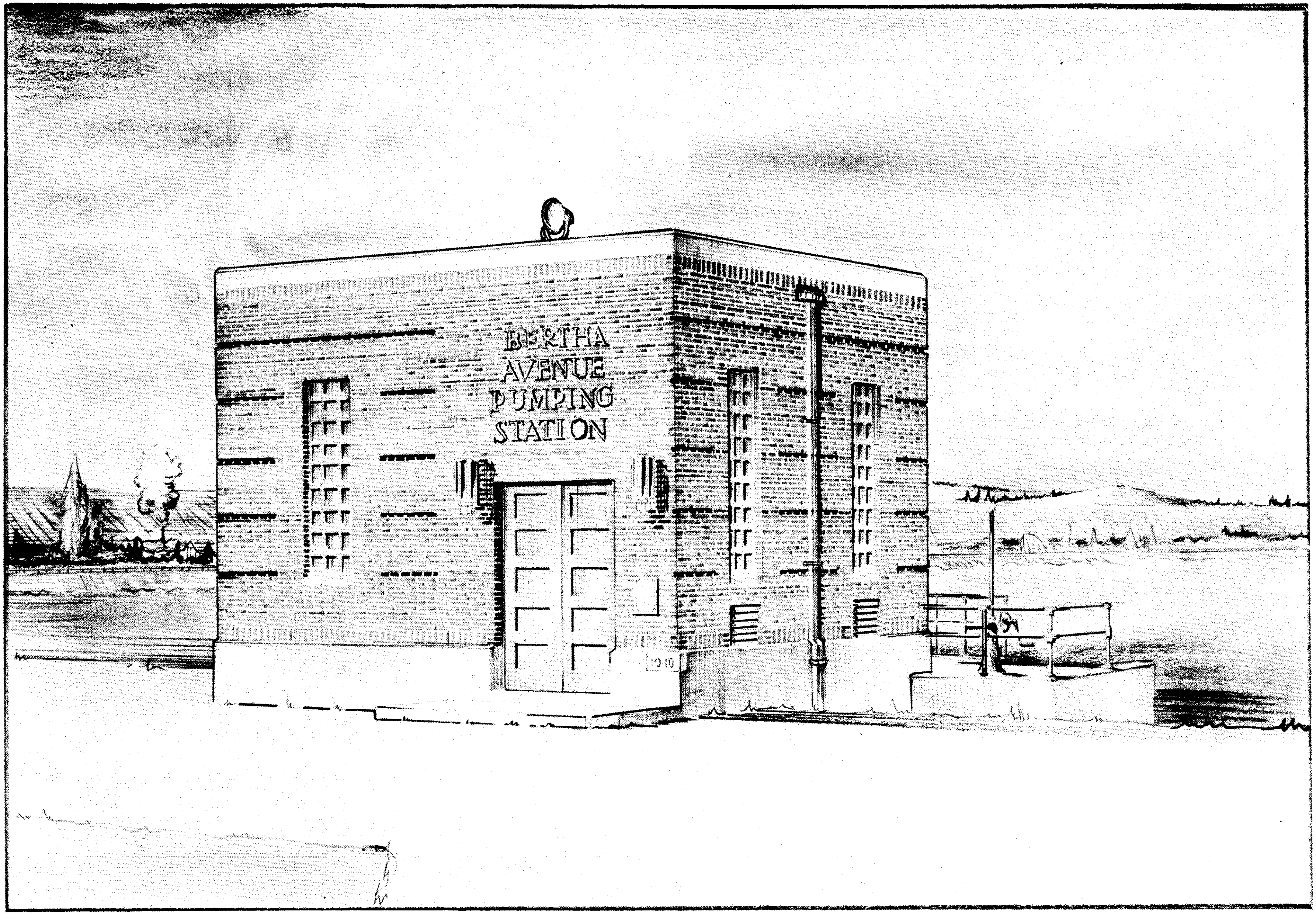
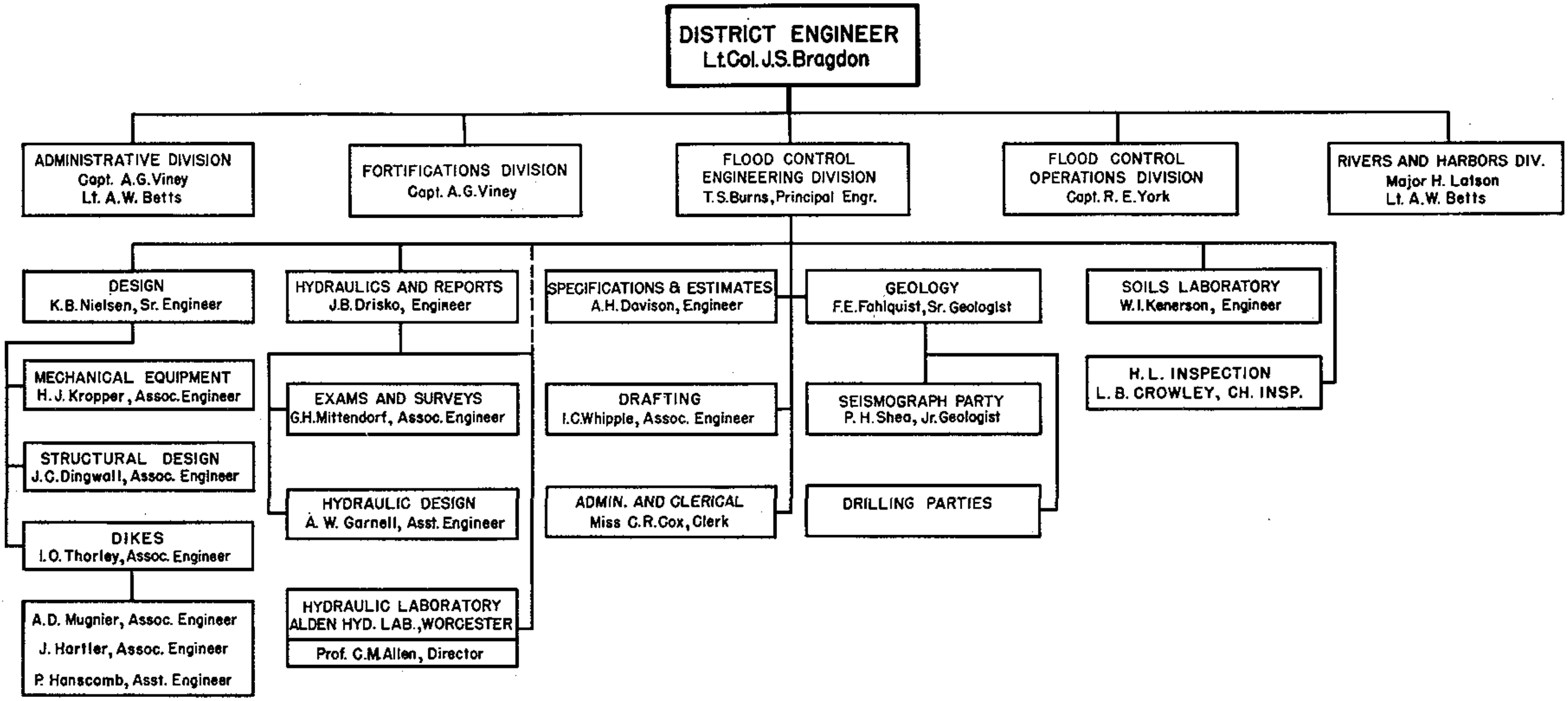


PLATE NO. 18



ORGANIZATION CHART

FLOOD CONTROL

ENGINEERING DIVISION

U.S. ENGINEER OFFICE, PROVIDENCE, R.I.

PLATE NO. 19